INDUCTIVE DATA COMMUNICATION

PRIORITY ENTITLEMENT

[0001] This application is entitled to priority based on Provisional Patent Application Ser. Nos. 61/312,246; 61/312,247; 61/312,248; and 61/312,249; filed on Mar. 10, 2010, which are incorporated herein for all purposes by this reference. This application and the Provisional Patent Applications have at least one common inventor.

TECHNICAL FIELD

[0002] The invention relates to wireless data transfer. In particular, the invention is directed to wireless data transfer apparatus and methods using coupled inductors.

BACKGROUND OF THE INVENTION

[0003] It is known to use coupled inductors to facilitate wireless data transfer. Wireless power transmission can also be accomplished using coupled inductors. Several challenges arise in using coupled inductors for sending and receiving data in the presence of active inductive power transmission. Among them, maintaining data integrity and bandwidth are of concern.

[0004] Due to these and other problems and potential problems, improved couple inductor power and data transmission would be useful and advantageous contributions to the arts.

SUMMARY OF THE INVENTION

[0005] In carrying out the principles of the present invention, in accordance with preferred embodiments, the invention provides advances in the arts with novel methods and apparatus directed to the transfer of data using an inductive coupling. In preferred embodiments, systems include capabilities for power transfer as well as unidirectional and bidirectional data transfer.

[0006] According to aspects of the invention, examples of preferred embodiments include data transmission systems and methods with a transmitter inductor for wirelessly transmitting a data signal to a receiver inductor. An error detector is provided for identifying data error. The error detector triggers the performance of a receiver error correction algorithm and/or a transmission error correction algorithm.

[0007] According to additional aspects of the invention, in examples of preferred embodiments, oversampling may be used to increase and decrease sample size, increase and decrease the number of sample points, or shift the sample window in response to the receiver error correction algorithm.

[0008] According to more aspects of the invention, preferred embodiments also include capabilities for responsively increasing and decreasing the transmission power and/or frequency based on the transmission error correction algorithm.

[0009] According to another aspect of the invention, preferred systems and methods are adapted for transmitting and receiving both power and data

[0010] According to an additional aspect of the invention, the preferred systems and methods may be implemented in configurations adapted for the bidirectional exchange of data.

[0011] The invention has advantages including but not limited to one or more of, improved bandwidth, improved data integrity, and improved power transfer control. These and other advantageous features and benefits of the present invention can be understood by one skilled in the arts upon careful consideration of the detailed description of representative embodiments of the invention in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention will be more clearly understood from consideration of the following detailed description and drawings in which:

[0013] FIG. **1** is a simplified schematic circuit diagram illustrating an example of preferred embodiments of systems for wireless data communication according to the invention;

[0014] FIG. **2** is a diagram illustrating an example of an algorithm for controlling the operation of systems and methods for receiving wireless data according to an exemplary embodiment of the invention;

[0015] FIG. **3** is a diagram illustrating an example of an algorithm for controlling the operation of systems and methods for transmitting wireless data communication according to an exemplary embodiment of the invention; and

[0016] FIG. **4** is a diagram illustrating an example of an algorithm for controlling the operation of systems and methods for wireless data communication according to an exemplary embodiment of the invention.

[0017] References in the detailed description correspond to like references in the various drawings unless otherwise noted. Descriptive and directional terms used in the written description such as right, left, back, top, bottom, upper, side, et cetera, refer to the drawings themselves as laid out on the paper and not to physical limitations of the invention unless specifically noted. The drawings are not to scale, and some features of embodiments shown and discussed are simplified or amplified for illustrating principles and features, as well as anticipated and unanticipated advantages of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] A related application, which is hereby incorporated herein for all purposes by this reference, U.S. patent application Ser. No. 12/813,180 includes wireless data receiving systems and techniques using coupled inductors. The related application and the present application have a common assignee and at least one inventor in common.

[0019] It has been determined that high inductance coils (micro-Henries) switched at low frequencies (hundreds of kHz) are effective for power transfer in applications such as battery chargers and power converters, for example. In order to transmit a high bandwidth of data effectively, however, several challenges arise. Tuning of the system is often required in order to optimize transmission frequency in the presence of parasitic elements that cause ringing or otherwise distort the data signal. Managing peak currents in the inductors, maintaining bandwidth in the presence of varying system conditions, e.g., changes in temperature, coil alignment, or distance between coils, and interference when sending and receiving data in the presence of inductive power transmission can also present problems. The inventors have determined that a reliable system for data and power transmission can be implemented, preferably using smaller inductance coils (10's to 100's of nano-Henries), switched at much higher frequencies (10's to 100's of MHz).

[0020] A simple illustration is shown in FIG. **1**. The system **100** includes a transmitter **102** having a transmitting inductor **104**. A receiver **106** has a receiver inductor **108**. Preferably,